



Problem Resolution Support for the En Route Sector Team

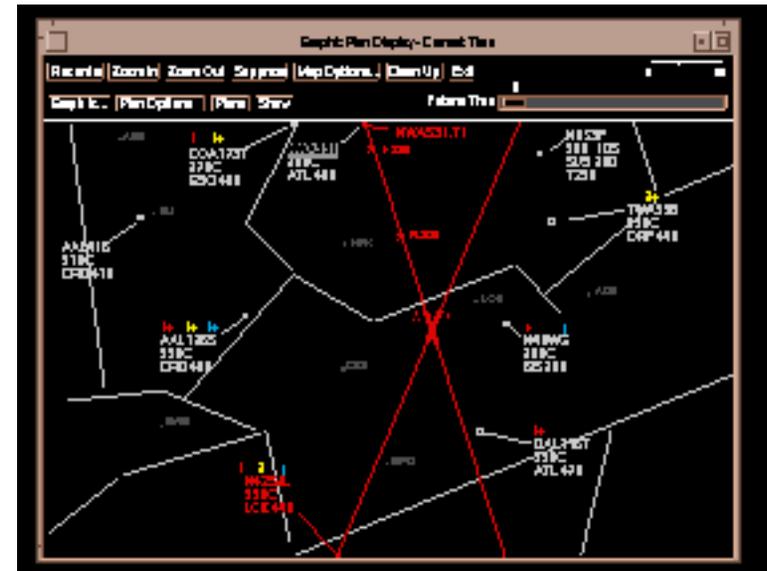
Eugene B. Wilhelm
DAG-TM Workshop, 22-24 May 2000

Outline

- **User Request Evaluation Tool (URET)**
 - Capabilities for Free Flight Phase 1
 - Use of Trial Planning in URET
- **Problem Resolution Enhancements to URET**
 - Overview
 - Expected Benefits
 - Problem Analysis, Resolution, and Ranking (PARR)
 - Schedule for Research

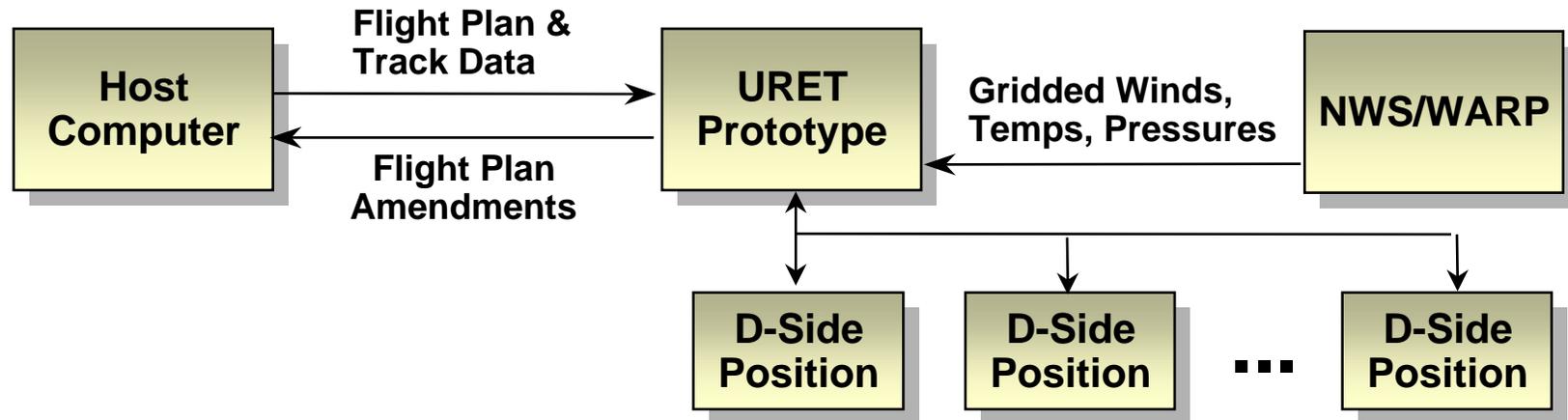
Major URET Capabilities

- Aircraft-to-Aircraft Conflict Detection
- Aircraft-to-Airspace Conflict Detection
- Evaluation of user or controller requests for flight plan amendments
 - Route or Altitude Changes
 - Airspeed Adjustments



Flight ID	Alt.	Time	Route
AA1122	330	000	AA1122
AA1123	330	000	AA1123
AA1124	330	000	AA1124
AA1125	330	000	AA1125
AA1126	330	000	AA1126
AA1127	330	000	AA1127
AA1128	330	000	AA1128
AA1129	330	000	AA1129
AA1130	330	000	AA1130

Detail of URET Capabilities



URET Functions:

- *Trajectory Modeling*
- *Conformance Monitoring*
- *Re-conformance Processing*
- *Conflict Prediction up to 20 min.*
 - *Aircraft-to-Aircraft with Probabilistic Notification Logic*
 - *Aircraft-to-Airspace*
- *Sector Notification Logic*
- *Trial Planning*
- *Automated Re-planning*
- *Automated Coordination*
- *Text & Graphic Displays*
 - *Point and Click Interface, including Host FP amendments*

R&D Positions Showing DSR and URET

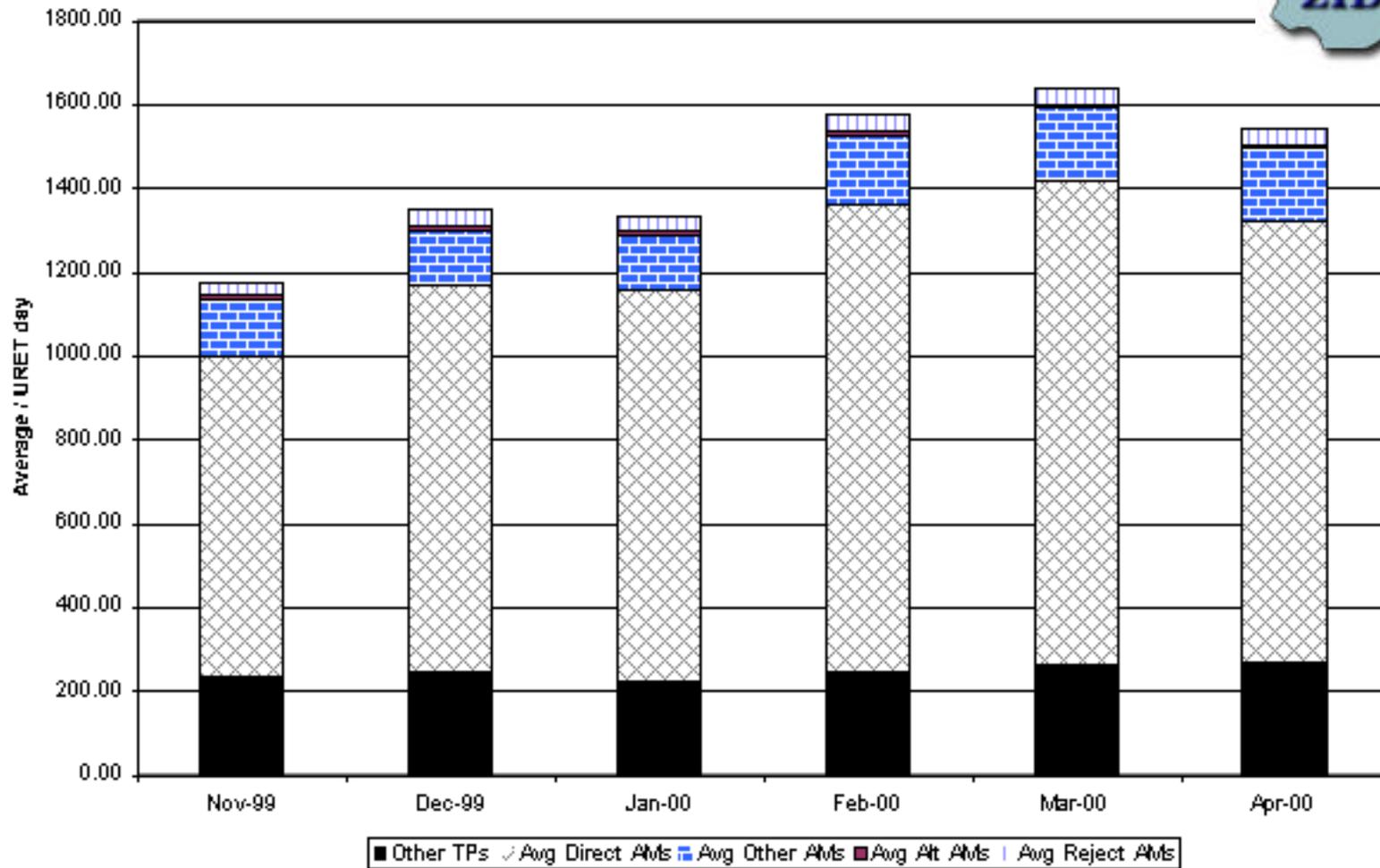


MITRE

CAASD

ZID: Average Number of Trial Plans Created

Monthly ZID TP Averages



Jan00 dip due to reduced operations for 1 week
Data through 23 Apr 00



Overview of Problem Resolution Enhancements

- **Development of strategic resolutions for:**
 - Aircraft-to-aircraft and aircraft-to-airspace conflicts
 - Traffic management metering time compliance
 - Hazardous weather problems
 - Flow restriction problems, e.g., MIT, Specified Routes
- **Development of conflict-free plans for desired actions, e.g.,**
 - Changing the assigned altitude due to turbulence
- **Integration of these tools into a common toolset for the D and R positions**

Expected Benefits

- **Controller workload reduction**
 - Conflict resolution made easier
 - Strategic resolutions reduce downstream workload
- **Safety benefits**
 - Fewer tactical maneuvers
 - Improved situational awareness
- **Increased User Benefits**
 - Support for developing conflict-free plans to meet user requests
 - Improved ability to reduce restrictions, handle increased traffic
 - Greater efficiency of strategic, optimized resolutions
- **Improved availability of intent data for use in conflict probe, e.g.**
 - Modeling of flow restrictions, such as metering and MIT constraints



PARR Overview

- **Derived from AERA 2 concepts/prototype software**
 - Extensive AT Controller Team evaluations in Late 1980s/early 1990s
- **Searches for conflict-free trajectories**
 - Can resolve multiple Aircraft-to-Aircraft (AC/AC), Aircraft-to-Airspace (AC/AS) and/or Meter Fix Time (MFT) problems simultaneously
- **Controller initiated, either**
 - For an aircraft
 - Maneuvers generated only for that aircraft
 - For a problem
 - Maneuvers generated for each involved aircraft
- **Up to 5 maneuvers per aircraft**
 - Left, right, above, below, and speed increase/decrease
- **Resulting resolutions are ranked for display**



PARR Aircraft-to-Aircraft Conflict Resolution



MITRE

CAASD

Resolution List

Send AM to Host Send QQ to Host Auto-coordinate

Open/Close Graphic Plan Display (GPD)
 Recenter GPD on Plan
 Vertical Profile Display
 Up (left click)/down (right click) in list
 Regenerate resolutions
 Exit
 (button function text appears after dwell)
 ACID, AC Type/equip, Data Block Fields
 Resl Rank #1: Turn right 35° to OBK
 Resl Rank #3: Climb to FL240; in 14 minutes, climb to FL280

The screenshot shows a window titled "Resolution List" with a dark background and white text. At the top, there are several icons: "AM", "QQ", a symbol with a subscript 'c', a symbol with a subscript 'G', a symbol with a subscript 'S', a symbol with a subscript 'V', a vertical profile icon, a circular arrow icon labeled 'R', and an 'X' icon. Below the icons, the text "COM615(34) CARJ/F 280T210 MSN 350" is displayed. The first resolution command, "→35° OBK (.T19)", is highlighted in green. Other resolution commands include "←40° [5: →80° MSN] (.T18)", "↑240 [14: ↑280] (.T17)", "↑330 (.T16) UPS2901", and "[5: -40K][22: resume] (.T20) EWW381".

Probed Altitude and Route Menus

Altitude Menu

NWA1547

330

370

350

330 ← Cleared Altitude

310

290

280 ← probed altitudes

270

260

250 ← Probed Direct-to-Fix maneuvers

240

230

220

210

200

190

180

170

160

150

140

130

Exit

Route Menu

AAL830 MD80/A

OMA./ .IMPCO .UKW3 .DFW/1319

Direct-To-Fix

Override Preferential Arrival Route

MOOSE BAMBE

ACKME KAGLE

MASTY HIKAY

UKW DFW

Apply ATC Preferred Route

Route String Amendment

KAGLE

Flight Data

Previous Route

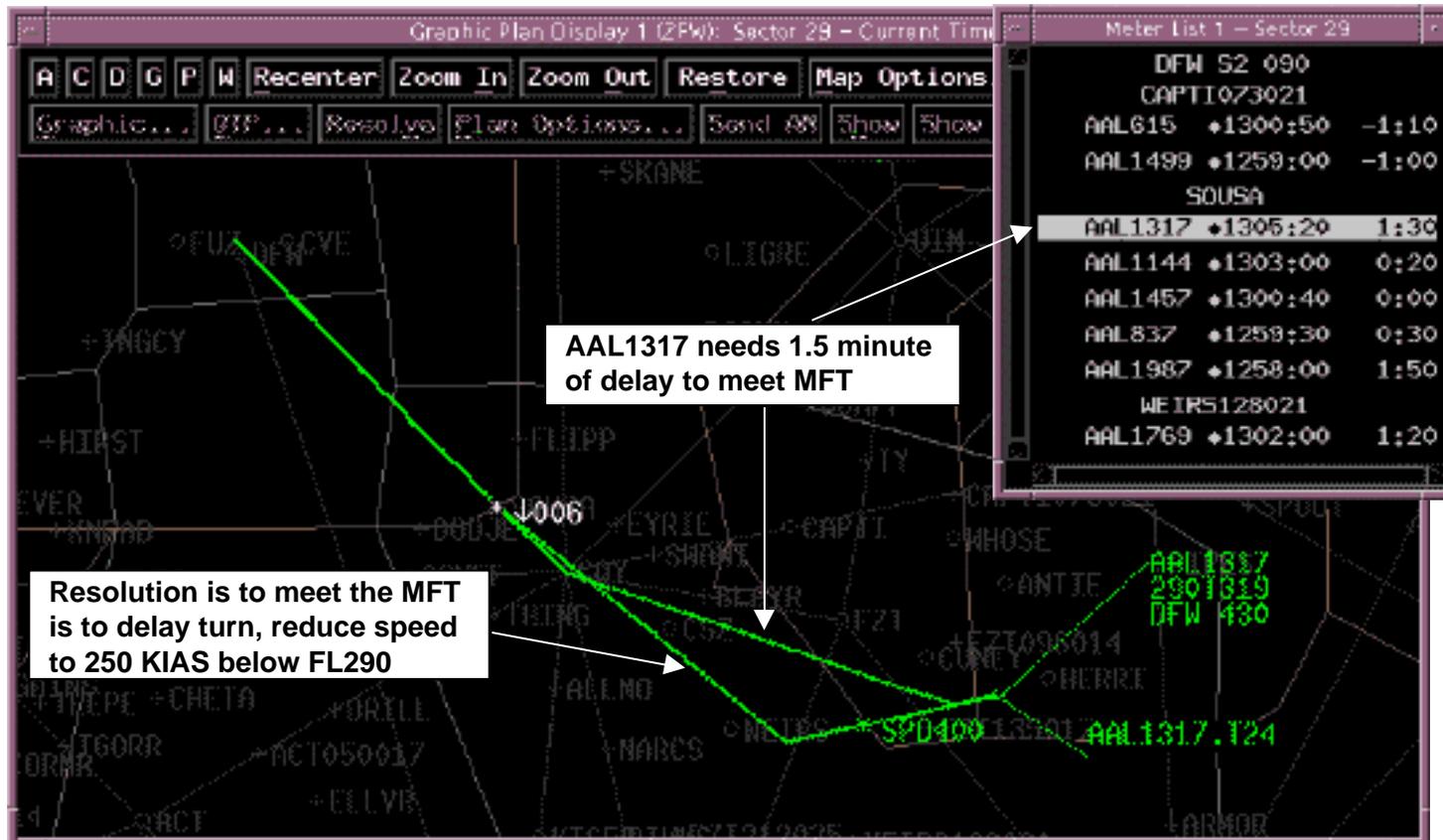
Similar to AERA Quick Trial Planning; Similar probed altitude menu previously implemented by NASA Ames

MITRE

CAASD

PARR Meter Fix Time Resolutions

- Ft. Worth scenario; TMA Meter Fix Times



Schedule (Completion of Concept Exploration, Start of Pre-Production Prototype Development)

- **Initial resolution enhancements..... 6/00, 12/01**
- **Resolutions for compliance with assigned metering times..... 12/00, 12/02**
- **Resolutions for avoidance of hazardous weather areas..... 12/00, 12/03**
- **Resolutions for compliance with flow restrictions 12/00, 12/03**
- **Integration of these tools with en route sector team DSS (D- and R-side)..... 12/00, 12/04**